

FORM PTO-1390 (REV 11-98)	U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY'S DOCKET NUMBER 677-18
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5) <b>09/673106</b> To be Assigned
INTERNATIONAL APPLICATION NO. <b>PCT/FR99/00837</b>	INTERNATIONAL FILING DATE <b>9 April 1999</b>	PRIORITY DATE CLAIMED <b>9 April 1998</b>
TITLE OF INVENTION <b>A METHOD OF MODIFYING IN INDIVISIBLE MANNER A PLURALITY OF NON-VOLATILE MEMORY LOCATIONS IN A MICROCIRCUIT CARD, IN PARTICULAR IN A CONTACTLESS CARD</b>		
APPLICANT(S) FOR DO/EO/US <b>GRIEU et al</b>		
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
<p>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input checked="" type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).</p> <p>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19<sup>th</sup> month from the earliest claimed priority date.</p> <p>5. A copy of the International Application as filed (35 U.S.C. 371(c)(2)).</p> <p>a. <input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).  b. <input type="checkbox"/> has been transmitted by the International Bureau.  c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</p> <p>6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).</p> <p>7. <input type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).  b. <input type="checkbox"/> have been transmitted by the International Bureau.  c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has <b>NOT</b> expired.  d. <input type="checkbox"/> have not been made and will not be made.</p> <p>8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (U.S.C. 371(c)(3)).</p> <p>9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p>		
Items 11. To 16. Below concern document(s) or information included:		
<p>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98.</p> <p>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 C.F.R. 3.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment.  <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</p> <p>14. <input type="checkbox"/> A substitute specification.</p> <p>15. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>16. <input checked="" type="checkbox"/> Other items or information. <b>International &amp; French Search Reports; Certificate of Translation</b></p>		



**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Patent Application of

GRIEU et al

Atty. Ref.: 677-18

Serial No. To Be Assigned

Group:

Filed: October 10, 2000

Examiner:

For: A METHOD OF MODIFYING IN  
INDIVISIBLE MANNER A PLURALITY OF  
NON-VOLATILE MEMORY LOCATIONS IN  
A MICROCIRCUIT CARD, IN PARTICULAR  
IN A CONTACTLESS CARD

\* \* \* \* \*

October 10, 2000

Assistant Commissioner for Patents  
Washington, DC 20231

Sir:

**PRELIMINARY AMENDMENT**

In order to place the above-identified application in better condition for  
examination, please amend the application as follows:

**IN THE CLAIMS**

Claim 4, line 1, delete, "or 2".

Claim 5, line 1, change, "any one of claims 1 to 4" to - -claim 1--.

Claim 7, line 1, change, "claims 4 and 6" to - -claim 4--.

Claim 9, line 1, change, "claims 4 and 8" to - -claim 4--.

Claim 10, line 1, delete, "or 2".

Claim 11, line 1, change, "claims 1 and 4" to - -claim 1--.

Claim 12, line 1, change, "claim 1 or 2" to - -claim 1--.

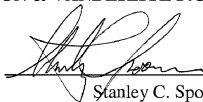
**REMARKS**

The above amendments are made to place the claims in a more traditional format.

Respectfully submitted,

**NIXON & VANDERHYE P.C.**

By:



Stanley C. Spooner  
Reg. No. 27,393

SCS:pd  
1100 North Glebe Road, 8th Floor  
Arlington, VA 22201-4714  
Telephone: (703) 816-4000  
Facsimile: (703) 816-4100

A METHOD OF MODIFYING IN INDIVISIBLE MANNER A PLURALITY OF NON-VOLATILE MEMORY LOCATIONS IN A MICROCIRCUIT CARD, IN PARTICULAR IN A CONTACTLESS CARD

5 The invention relates to microcircuit cards, and more particularly to microprocessor cards which themselves perform various modifications to their own non-volatile memory.

When executing a transaction, the memory is generally modified one or more times, and, naturally, it is necessary to ensure that all of the modifications have been performed correctly before being in a position to make use of the newly recorded information, and the newly recorded information must be ignored or erased in the event of an error or of the record suffering from corruption.

15 US-A-4 877 945 thus describes how to detect an anomaly that occurs during a write sequence for a plurality of data items so as to prevent the transaction being continued on an erroneous basis.

20 In the event of an anomaly, it is also desirable to be able to return to the *status quo*, i.e. for a subsequent transaction to be in a position to operate on the information values that were recorded in the card before it executed the incorrect transaction.

25 Above-mentioned US-A-4 877 945 does not offer that advantage, since in some cases the old information values will have been lost during execution of the incorrect transaction, such that it will not be possible to restore said information to its earlier state, at least not solely on the basis of information contained in the card.

30 WO-A-89/02140 describes one such manner of operating, but it is applicable only to the case when a single item of information has been modified or when a plurality of items are modified independently of one another.

However, in many cases, it is necessary to modify a plurality of items of information during a single

transaction, and they are considered as being "mutually interdependent" when they need to be processed together to ensure that all of the modifications to the plurality of items of information have been properly executed.

- 5       The risk of an imperfect or uncompleted transaction bearing on a plurality of interdependent items of information is particularly high with cards of the "contactless" type where the boundaries of the volume within which the card can operate correctly around the terminal are not perceptible. Under such circumstances, there is a non-negligible risk of communication between the card and the terminal being interrupted unexpectedly, either because the card moves beyond the range of the terminal before the end of processing, or because of a transient disturbance, for example a mass of metal passing close by.
- 10
- 15

- An example (which is naturally not limiting) is the use of such a card in a remote ticketing transaction, i.e. for access to a public transport network, where the card performs two roles: that of a travel ticket proper; and that of an electronic purse.
- 20

- Several solutions have already been proposed to mitigate the above difficulties and to make a plurality of writes or other modifications to interdependent data items "indivisible".
- 25

- In the particular application given above as an example, known systems begin by debiting the purse, and then they record the travel rights that have been acquired by the user. If the user withdraws the card between those two operations, then the user is invited to present the card again and the writing of travel rights is restarted. However, if the user goes away without presenting the card again, then the user will have been wronged. Clearly it is not possible to proceed in the opposite order since the user would then be tempted to withdraw the card before the purse had been debited.
- 30
- 35

That solution implies that the terminal is specially configured to make it possible, in the event of an interruption, to activate exception processing for handling the restarting of a transaction (reinserting the card in the terminal on request). In addition to making the software of the terminal more complex, that solution is not entirely satisfactory insofar, as mentioned, the user can still be wronged in the event of the transaction not being restarted.

Another solution consists in data crossing, where the terminal conserves information about the state of the purse in the card, and vice versa. However that solution is not satisfactory either since in addition to being complex, it increases the volume of data interchanged between the card and the terminal and therefore slows down execution of a transaction. It is also difficult to apply when a large number (three or more) of writes are to be made indivisible.

One of the objects of the invention is to propose a method enabling a plurality of modifications to be made in the memory of the card in indivisible manner.

Another object of the invention is to propose such a method which can be handled entirely by the card. The method can thus be implemented without modifying terminals and without there being any need to provide exception processing in the terminals, the method using the syntax of existing orders and thus being very flexible in the commands that can be selected.

The method of the invention is of the type in which the card is coupled temporarily to a terminal while a transaction is being executed, the transaction including the terminal applying to the card a plurality of modification commands, each comprising at least one operation of recording in the card memory a respective data item designated by the command, the various data items recorded in this way being mutually interdependent.

In a manner characteristic of the invention, this method comprises the execution by the card of the following steps: a) on receiving corresponding respective commands from the terminal, it modifies the contents of the card memory by provisionally recording in the card memory each of said interdependent items of information without losing prior values corresponding to said items; and then b) the modifications are finalized either by all of them being confirmed or by all of them being discarded, such that for subsequent operations, the commands executed in step a) will either all have been taken into account, or else all of them will be without effect.

The principle on which the invention is based thus consists in grouping together the plurality of modifications that are to be made in indivisible manner within a single step a) and then after the modifications have been executed, in the card validating these modifications overall. If validation is successful, then on the next operation performed by the card (whether during the same transaction or during a subsequent transaction), the accessible content will necessarily reflect the modifications that have been made.

Conversely, any interruption in the operation of the card taking place during step a) will cancel all of the modifications performed, and the data in the non-volatile memory will remain in its state prior to step a).

In a particular implementation, in the event of confirmation in step b), a flag confirming proper execution is recorded in the memory of the card; and when the card subsequently receives a command requiring at least one of the data items written in step a) or the value corresponding thereto to be read and/or modified, the card begins by examining the state of the flag, and if it has not been recorded, the card ignores or cancels the provisional recordings previously made in step a) and executes the command on the basis of said prior values



corresponding to the data items. If, when the card examines the state of the flag, it is found to have been recorded, then the card can execute operations of copying the provisional writes performed in step a).

5 Most advantageously, the card is suitable for operating in two modes, namely: an in-session mode in which recordings are made by executing steps a) and b); and an out-of-session mode in which the making of recordings is not confirmed to all of steps a) and b).

10 The opening of a session can be implicit, e.g. by the card being reset to zero, or it can follow a command having two actions, executing a predetermined operation and being interpreted as an order to open a session.

15 For example, when a normally-certified recording is not accompanied by a certificate, the card automatically opens a session which processes recording in this session.

20 In the same manner, closure of a session can be implicit, following a command that performs two actions: executing a predetermined operation and being interpreted as an order to close a session.

25 For example, an operation of debiting the purse closes the session, thereby also avoiding any need to defer communication of the resulting certificate and making it possible for session certificates and purse transaction certificates to be indistinguishable.

30 Most advantageously, the method comprises an authentication function combined with the function of finalizing step b), forcing step b) to be discarded in the event of authentication failing.

35 In a first implementation, said authentication is performed by the card which authenticates the terminal and/or the data interchanged between the terminal and the card, the card checking a cryptographic certificate produced by the terminal and transmitted to the card, and confirming the modifications in step b) only if the certificate is recognized as being correct.

In a mode with a session, provision can be made, so that when the card receives from the terminal commands for modifying the content of the memory and including verification of a cryptographic certificate, said  
5 verification is performed if the command is received out-of-session, and it is not performed if the command is received in-session.

In other words, those of the commands that are executed by the card in step b) and that would normally  
10 (i.e. out-of-session) verify a cryptographic certificate, no longer include this verification when they are executed in-session, with the "session certificate authenticating the terminal" performing an equivalent function.

In a second implementation, said authentication is performed by the terminal which authenticates the card and/or the data interchanged between the terminal and the card, the card producing and transmitting a cryptographic certificate in conditional manner to the terminal, if and  
15 only if the modifications have been confirmed in step b).

In a mode with a session, provision can be made so that when the card receives from the terminal commands for modifying the contents of the memory and including the production of a cryptographic certificate, said  
20 production is performed if the command is received out-of-session, and is not performed if the command is received in-session.

In other words, those of the commands that are executed by the card in step b) and that would normally  
30 (i.e. out-of-session) produce a cryptographic certificate, no longer produce such a certificate when they are executed in-session, with the "session certificate authenticating the terminal" performing an equivalent function.

Provision can also be made so that when the card receives from the terminal in step b) commands for  
35 modifying the contents of the memory and including the

production of a plurality of cryptographic certificates, these certificates are stored in step b), and then transmitted together to the terminal if, and only if, the modifications have been confirmed in step b).

5        In other words, provision is made to defer communication by the card of cryptographic certificates normally produced by the orders of step b). In particular, if a certified write command produces a certain write certificate, it is desirable for the  
10       certificate to leave the card only after the write has been performed irrevocably.

         In a particular implementation, at least some of the commands that may be executed in step b) include an optional inhibit attribute, and if the card executes such  
15       a command in-session in a step b), the modifications performed by said command take effect independently of the result of step b).

         In other words, the attribute defines whether the command is performed in-session (i.e. will be cancelled  
20       if the session is not closed) or out-of-session (i.e. is immediately effective as though it had been performed out-of-session, even if chronologically speaking it is in-session).

         Most advantageously, the invention further provides, after step b) and in the event of modifications being  
25       confirmed, the following sequence of steps: d) the terminal executes an action following confirmation by the card; and e) in the event of said action being properly performed by the terminal, ratification information is  
30       recorded in the card suitable for subsequent accessing by reading.

         Such "ratification" of the session informs the card that the terminal has indeed been able to take decisions (e.g. opening a barrier in an application to giving  
35       access to a public transport network) following execution of the session.

It will be observed that this ratification is handled by the card without needing an additional write (the copying of provisional writes being an operation which in any event must be performed sooner or later).

- 5 In addition, this copying is performed at the card end only on condition that the action has been properly executed at the terminal end, i.e. only if the entire transaction is consistent.

- 10 With all of the operations being handled by the card, provision can advantageously be made for the recording command of step e) to be an implicit command, any command received by the card after step b) being interpreted as an order for recording ratification information in the card.

- 15 Other characteristics and advantages appear from the following description of two implementations of the invention.

- 20 In these examples, and indeed throughout the text, the word "designate" is used in its sense of "specify one of a plurality", and relates to the action which consists in characterizing a particular item of information amongst the various items contained in the card.

- Such designation can be implicit because the command itself specifies a particular item of information; for  
25 example the command "debit the amount  $x$  from the purse" designates the memory location that contains the value of the "purse balance" data item.

- Designation can also be explicit, as for example in Example I below, where provision is made for write  
30 commands to have an address or a sector identifier, with the commands being indexed by an index  $i$ .

#### **Example I**

- A card is provided that stores 100 8-byte values,  
35 and capable of performing the following orders:

- reading an 8-byte value  $v$  as specified by an index  $i$  in the range 1 to 100;

- writing an 8-byte value  $v$  as specified by an index  $i$  in the range 1 to 100;
- opening a session;
- closing a session.

5       The card must allow up to three writes within a single session. By convention, upper case letters are used to designate values in non-volatile memory (e.g. EEPROM) and lower case letters are used to designate values in volatile memory (RAM, whose contents is lost when not powered).

A non-volatile memory zone is allocated to main data storage of the card (definitive writes):

- $V[i]$ , for  $i$  in the range 1 to 100:  $100 \times 8$  bytes.

15       Another non-volatile memory zone is allocated to the session mechanism, and comprises:

- $T[k]$ , for  $j$  in the range 1 to 3:  $3 \times 8$  bytes containing the values written during the session (provisional writes);

20       ·  $I[k]$ , for  $j$  in the range 1 to 3:  $3 \times 1$  byte containing the indices of the values written during the session; and

- $C$ : a count byte that is written at the end of the session.

25        $C$  encodes the number of writes performed in the session; an appropriate redundancy mechanism (e.g. associating the complement of said value) makes it possible to detect the case where the value stored in said count byte is uncertain.

The operations take places as follows.

30       Step 0: at a moment between the card being powered and the first command being performed,  $C$  is examined. If it is a value that is certain in the range 1 to 3, then for  $k$  equals 1 to  $C$  the value  $T[k]$  at index  $I[k]$  is copied from the table  $V[i]$ . Thereafter,  $C$  is reset to zero and an internal variable  $j$  is set to -1 (to indicate that a session is not open).

Step 1: on reading, a test is made to see whether  $j > 0$ ; if yes, the requested index  $i$  is compared with the values of  $I[k]$  for  $k$  from  $j$  to 1 in decreasing order. If there is a match,  $T[k]$  is returned. In all other cases,  
 5  $V[i]$  is returned.

Step 2: on opening a session,  $j$  is initialized to 0 (if a session is already open, it is cancelled).

Step 3: on each write, if  $j = -1$  (session not open), the communicated value  $v$  is written in  $T[0]$ , the  
 10 communicated index  $i$  is written in  $I[0]$ , and then  $C = 1$  is written, after which  $v$  is written in  $V[i]$ , and  $C = 0$  is written; if  $0 \leq j < 3$  (writing in a session),  $j$  is increased by 1,  $v$  is written in  $T[j]$ , and  $i$  is written in  $I[j]$ ; if  $j = 3$  the operation is refused (the limit on  
 15 writes in a session has been exceeded).

Step 4: on closing a session, if  $j > 0$ ,  $j$  is written in  $C$ , and then for  $j$  from 1 to  $C$ , the value  $T[j]$  at index  $I[j]$  of the table  $V[]$  is copied. Then  $C$  is set to 0, and  $j$  to -1.

20 It is shown that the power supply of the card can be interrupted at any moment and that the values read will be correct, i.e. for each index  $i$  the last value written not in a session, or written in a session that has been closed (writing has been completed or a session has been  
 25 closed at the time a non-zero value is written in  $C$ ).

Cryptography is added to prevent certain operations if a cryptographic certificate supplied to the card is incorrect, and/or causing cryptographic certificates to be produced to the card at the end of certain operations.

30 The cryptographic certificates used are based on a known type of cryptography. For example, the "session certificate authenticating the card" (or the terminal) is obtained by applying the secure hash algorithm (SHA) at the card end and at the terminal end to data supplied by  
 35 the card (or the terminal) and to a random number supplied by the terminal (or the card) when the session is opened; the message authentication code (MAC) that

results therefrom is signed by the card (or the terminal) by the digital signature algorithm (DSA) using a secret key contained in the card (or the terminal); the terminal (or the card) verifies the signature using a public key.

- 5 A symmetrical cryptographic algorithm such as the data encryption standard (DES) can also be used for producing the MAC and/or generating signatures.

In an option of the invention, the step of producing the MAC is common in both directions of authentication, and bears on all of the data of the session. When using symmetrical cryptography, the certificate authenticating the card and the certificate authenticating the terminal are obtained by a single step of MAC enciphering, with the respective certificates for the card and the terminal being derived therefrom by an elementary operation such as extracting certain predetermined bits.

#### **Example II**

In this example, the data of the memory is organized as sectors, each sector comprising four fields:

1. data;
2. an identifier (an access key enabling a sector to be selected);
3. pertinence: for determining which sector is pertinent if two segments have the same identifier; and
4. check: for verifying that the three preceding fields are not corrupt (e.g. by performing a parity type check).

A sector is designated by its identifier, with this notion replacing that of an address. The procedure for writing in a sector has an identifier as a parameter together with the data for association with that identifier. The procedure for reading a sector has an identifier as its parameter, and it returns the data that was associated with the identifier on the last occasion a write was performed using that identifier (or an appropriate indication if the identifier has never been

used before). In other words, an associative type of access is implemented instead of indexed access.

During the procedure of reading a sector, the card searches for sectors having identifiers containing the requested value, and which are not corrupt (as determined by the check field). When a plurality of sectors satisfy these two criteria, a particular sector is retained on the basis of the pertinence field.

When writing a sector, the card writes the following in an available sector: the requested data; the identifier; a pertinence field such that, for the read procedure, this sector will be the most pertinent of non-corrupt sectors possessing this identifier; and a check field matching the three preceding fields (in other words, writing is handled in such a manner that a subsequent read can take place properly).

Advantageously, the write procedure is followed by erasing the sector that has been made non-pertinent by the new sector being written, thus making a new sector available.

Advantageously, an (additional) garbage collection type system is also provided, i.e. a system for recovering sectors that are not useful, either because they are corrupt or because they are not pertinent.

Advantageously, a system is provided which spreads out the wear that results from writing by ensuring that it is not always the same sectors that are used, e.g. by selecting a sector randomly from amongst the sectors that are available.

A generally advantageous variant of the procedure for searching for a sector consists in taking advantage of the search step to erase sectors that are found to be corrupt and/or sectors that are not the most pertinent, thereby recreating free sectors (that wastes time during a particular read, in favor of speed for subsequent reads and writes). Advantageously, prior to erasing a sector which has been found to be non-corrupt, but not



pertinent, the pertinent sector is written again since it may have been written improperly.

The working size of the memory is equal to the number of available sectors, minus one sector which must remain erased. All of the sectors (including the erased sector) are distributed dynamically within the memory.

If the data is to be structured in files, e.g. in application of the ISO/IEC 7816-4 standard, then the sector identifier is subdivided into two subfields: a file identifier; and an identifier for a sector within the file.

A non-limiting implementation of read/write operations using this particular sector structure is given below:

There follows a description of a (non-limiting) implementation of read/write operations using this particular sector structure:

- The check field contains in binary code the number of zero bits in the other three fields; it has been shown that if a problem such as an interrupted write or erase modifies any number of bits in the sector all in the same direction, then checking the value of the check field can always detect that the problem has occurred.

- The pertinence field is an integer in the range 0 to 3 encoded on 2 bits.

- The read procedure reads all of the sectors sequentially until it finds a first sector possessing the looked-for identifier and that is not corrupt. If no sector is found, then the procedure ends with a "sector not found" report. If a first such sector is found, its position is stored together with its data and its pertinence  $p$ . The search is continued. If a second sector is found possessing the looked-for identifier and that is not corrupt, it is tested whether its pertinence  $q$  is the remainder of integer division of  $p+1$  by 3; if "yes", then the second sector is rewritten, the first sector is erased, and the data from the second sector is

returned; otherwise, the first sector is rewritten, the second sector is erased, and data is returned from the first. If a second sector is not found and if the pertinence of the first sector is  $p=3$ , then this sector  
 5 is erased and a "sector not found" report is given; otherwise the data returned comes from the first found sector.

The write procedure begins like the above read procedure. If a previously-stored sector is found that  
 10 would have been returned by the read procedure for the given identifier, the position of this sector is retained together with its pertinence  $p$  (which is equal to 0, 1, or 2); if no such sector is found, then a free sector is selected (using the procedure described below) and the  
 15 identifier, data, pertinence  $p=3$ , and check fields are written to said sector, and the position and the pertinence of said sector is retained. In both cases, the procedure continues by selecting a free sector (using the procedure described below). The identifier, data,  
 20 pertinence  $q$  (calculated as the remainder of integer division of  $p+1$  by 3), and check fields are written to this sector. Thereafter the previously-stored sector, if any, is erased.

To look for a free sector, the number  $n$  of found  
 25 free sectors is initialized at zero. The sectors are examined in sequence. For each sector that is not empty and that is corrupt, the sector is erased so that it becomes empty (thus contributing to the above-mentioned garbage collection); if the sector is not corrupt and if  
 30 its pertinence is  $p=3$ , it is erased (also contributing to garbage collection); if the sector is not corrupt and if its pertinence is not  $p=3$ , then the zone that has not yet been scanned is searched for another non-corrupt sector having the same identifier, and if one is found, the non-pertinent sector is erased, proceeding as for reading; if  
 35 at the end of this process the sector is empty, the number  $n$  of found free sectors is incremented, and a

random integer is drawn in the range 0 to  $n-1$ ; if the integer is 0, the position of the empty sector is stored. When all of the sectors have been scanned, all non-empty sectors are not corrupt, no two sectors have the same identifier, the number  $n$  of empty sectors is known, and one of them has been stored as a random choice made in equiprobable manner. If no free sector is found, the write procedure is interrupted.

The way in which the card can handle indivisible modification sessions using such a particular sector structure is described below.

To store indivisible modifications, the card has  $N$  erased sectors available in non-volatile memory (where  $N$  corresponds to the number of indivisible modifications that might need to be made during a single session). In addition, the card handles a non-volatile memory zone (not included in the sectors) that is dedicated to handling a session and that is referred to as the "session descriptor".

This implementation has no authentication specific to a session.

A session descriptor is defined on three fields:

- a list of references to indivisible sectors (LRSA);
- a check value on creating the list of references to indivisible sectors (VCC); and
- a check value taking account of the list of references to indivisible sectors (VCPC), for discovering whether or not a session has been closed).

Step 0: initialization: before first access to data since the most recent interruption of card operation, e.g. on a reset, the card must ensure that the session descriptor is erased. Several cases need to be taken into consideration, depending on the state of the session descriptor:

- it is completely erased: the card leaves it unchanged;

· it is not completely erased, and the VCPC is correct: the card searches for and erases (where necessary) all of the sectors made obsolete by those that have been written (from those referenced in the list), and then it erases the session descriptor;

· it is not completely erased, the VCPC is erased or incorrect, and the VCC is correct: the card erases the sectors given in the LRSA and then it erases the session descriptor; or

· it is not completely erased, the VCPC is erased or incorrect and the VCC is erased or incorrect: the card erases the session descriptor.

Step 1: opening a session: the card looks for N erased sectors and then records the list of references thereto in its VCC in the session descriptor (assumed to be erased).

Step 2: session in progress: the card receives commands. When one of them gives rise to one or more indivisible modifications, the sectors used for recording these modifications are those recorded in the LRSA, up to a total of N modified sectors.

Step 3: closing a session: to close a session, the card writes the VCPC which ensures that the LRSA and its VCC have been taken into account. Thereafter it searches for and erases all of the sectors that have been made obsolete by those that it has written (from those referenced in the list). Thereafter, it erases the session descriptor.

In addition, if it is the card that handles ratification, session handling includes the following modifications:

Step 0: initialization: in the event that the session descriptor is not completely erased and the VCPC is correct, the card looks for and erases (where necessary) all of the sectors made obsolete by those that had been written (from those referenced in the list), but it does not erase the session descriptor.

Step 1: opening a session: the card records in volatile memory that a session is open. If the session descriptor is not empty, the card indicates that the preceding session has not been ratified and, by analyzing the LRSA, it can even indicate which data items have not been ratified. In any event, it does not modify the session descriptor.

Step 2: session in progress: during the first command with indivisible modifications, the card erases the session descriptor if necessary, searches for N erased sectors, and then writes the LRSA and its VCC.

Step 3: closing a session: the card records in volatile memory that no session is open. Whatever happens, it does not erase the session descriptor.

15

## CLAIMS

1/ A method of modifying the content of the non-volatile memory of a microcircuit card, in particular a contactless card,

5           in which method the card is temporarily coupled to a terminal while a transaction is being executed, in particular a remote ticketing transaction, the transaction including the terminal applying to the card a plurality of modification commands, each comprising at least one operation of recording in the card memory a  
10       respective data item designated by the command, the various data items recorded in this way being mutually interdependent,

          the method being characterized in that it comprises  
15       the card executing the following steps:

          a) on receiving corresponding respective commands from the terminal, it modifies the contents of the card memory by provisionally recording in the card memory each of said interdependent items of information without  
20       losing prior values corresponding to said items; and then

          b) the modifications are finalized either by all of them being confirmed or by all of them being discarded, such that for subsequent operations, the commands executed in step a) will either all have been taken into  
25       account, or else all of them will be without effect.

2/ The method of claim 1, in which:

          · in the event of confirmation in step b), a flag confirming proper execution is recorded in the memory of  
30       the card; and

          · when the card subsequently receives a command requiring at least one of the data items written in step a) or the value corresponding thereto to be read and/or modified, the card begins by examining the state of the  
35       flag, and if it has not been recorded, the card ignores or cancels the provisional recordings previously made in

step a) and executes the command on the basis of said prior values corresponding to the data items.

3/ The method of claim 2, in which, when the card  
5 examines the state of the flag, and if the flag has been recorded, the card executes operations for copying the provisional writes made in step a).

4/ The method of claim 1 or 2, in which the card is  
10 suitable for operating in two modes, namely:  
· an in-session mode in which recordings are made by executing steps a) and b); and  
· an out-of-session mode in which the making of recordings is not confirmed to all of steps a) and b).

15 5/ The method of any one of claims 1 to 4, comprising an authentication function combined with the function of finalizing step b), forcing step b) to be discarded in the event of authentication failing.

20 6/ The method of claim 5, in which said authentication is performed by the card which authenticates the terminal and/or the data interchanged between the terminal and the card, the card checking a cryptographic certificate  
25 produced by the terminal and transmitted to the card, and confirming the modifications in step b) only if the certificate is recognized as being correct.

7/ The method of claims 4 and 6 taken in combination, in  
30 which, when the card receives from the terminal commands for modifying the content of the memory and including verification of a cryptographic certificate, said verification is performed if the command is received out-of-session, and it is not performed if the command is  
35 received in-session.

8/ The method of claim 5, in which said authentication is performed by the terminal which authenticates the card and/or the data interchanged between the terminal and the card, the card producing and transmitting a cryptographic certificate in conditional manner to the terminal, if and only if the modifications have been confirmed in step b).

9/ The method of claims 4 and 8 taken in combination, in which, when the card receives from the terminal commands for modifying the contents of the memory and including the production of a cryptographic certificate, said production is performed if the command is received out-of-session, and is not performed if the command is received in-session.

10/ The method of claim 1 or 2, in which, when the card receives from the terminal in step b) commands for modifying the contents of the memory and including the production of a plurality of cryptographic certificates, these certificates are stored in step b), and then transmitted together to the terminal if, and only if the modifications have been confirmed in step b).

11/ The method of claims 1 and 4 taken in combination, in which at least some of the commands that may be executed in step b) include an optional inhibit attribute, and in which, if the card executes such a command in-session in a step b), the modifications performed by said command take effect independently of the result of step b).

12/ The method of claim 1 or 2, in which provision is further made, after step b) and in the event of modifications being confirmed, for the following sequence of steps to be performed:

d) the terminal executes an action following confirmation by the card; and



e) in the event of said action being properly performed by the terminal, ratification information is recorded in the card suitable for subsequent accessing by reading.

5

13/ The method of claim 12, in which the recording command of step e) is an implicit command, any command received by the card after step b) being interpreted as an order for recording ratification information in the

10

card.

## A B S T R A C T

A METHOD OF MODIFYING IN INDIVISIBLE MANNER A PLURALITY  
OF NON-VOLATILE MEMORY LOCATIONS IN A MICROCIRCUIT CARD,  
5 IN PARTICULAR IN A CONTACTLESS CARD

The card is coupled temporarily to a terminal while  
a transaction is being executed that includes the  
terminal applying a plurality of modification commands to  
10 the card, each comprising at least one operation of  
recording, in the memory of the card, a respective item  
of information specified by the command, the various  
items of information written in this way being mutually  
interdependent. The method comprises execution by the  
15 card of the following steps: a) on receiving  
corresponding respective commands from the terminal, it  
modifies the contents of the card memory by provisionally  
recording in the card memory each of said interdependent  
items of information without losing prior values  
20 corresponding to said items; and then b) the  
modifications are finalized either by all of them being  
confirmed or by all of them being discarded, such that  
for subsequent operations, the commands executed in step  
a) will either all have been taken into account, or else  
25 all of them will be without effect.

30

Translation of the title and the abstract as they were when originally filed by the  
35 Applicant. No account has been taken of any changes that may have been made  
subsequently by the PCT Authorities acting ex officio, e.g. under PCT Rules 37.2,  
38.2, and/or 48.3.

Applicant or Patentee: GRIEU et al Attorney's Dkt. No. 677-18  
 Serial or Patent No.: \_\_\_\_\_  
 Filed or Issued: \_\_\_\_\_  
 For: **A METHOD OF MODIFYING IN INDIVISIBLE MANNER A PLURALITY OF NON-VOLATILE MEMORY LOCATIONS IN A MICROCIRCUIT CARD, IN PARTICULAR IN A CONTACTLESS CARD**

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS [37 19(f) and 1.27(c)] - SMALL BUSINESS CONCERN**

I hereby declare that I am



the owner of the small business concern identified below:



an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF CONCERN INNOVATRON ELECTRONIQUE

ADDRESS OF CONCERN 1, rue Danton, Paris, 75006 FRANCE

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention, entitled:

**A METHOD OF MODIFYING IN INDIVISIBLE MANNER A PLURALITY OF NON-VOLATILE MEMORY LOCATIONS IN A MICROCIRCUIT CARD, IN PARTICULAR IN A CONTACTLESS CARD**

by inventors GRIEU et al described in \_\_\_\_\_  
☐ the specification filed herewith.  
☒ PCT application Serial PCT/FR99/00837, filed 9 April 1999  
 No. \_\_\_\_\_  
☐ patent No. \_\_\_\_\_, issued \_\_\_\_\_

If the rights held by the above-identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below\* and no rights to the invention are held by any person, other than the inventor who could not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e). \*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities (37 CFR 1.27)

Name \_\_\_\_\_

Address \_\_\_\_\_

☐ Individual

☐ Small Business Concern

☐ Nonprofit Organization

Name \_\_\_\_\_

Address \_\_\_\_\_

☐ Individual

☐ Small Business Concern

☐ Nonprofit Organization

I acknowledge the duty to file, in this application of patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. [37 CFR 1.28(b)]

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING Roland Moreno  
 TITLE OF PERSON OTHER THAN OWNER President  
 ADDRESS OF PERSON SIGNING 3 rue de l'Ancienne Comédie, 75006 Paris  
 SIGNATURE \_\_\_\_\_ DATE October 28th 2000

**RULE 63 (37 C.F.R. 1.63)**  
**INVENTORS DECLARATION FOR PATENT APPLICATION**  
**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:  
**A METHOD OF MODIFYING IN INDIVISIBLE MANNER A PLURALITY OF NON-VOLATILE MEMORY LOCATIONS IN A MICROCIRCUIT CARD, IN PARTICULAR IN A CONTACTLESS CARD**

the specification of which (check applicable box(es)):

☐ is attached hereto  
☐ was filed on \_\_\_\_\_ as U.S. Application Serial No. \_\_\_\_\_ (Atty Dkt. No. 677-18)  
☒ was filed on PCT International application No. PCT/FR99/00837 on 9 April 1999  
and (if applicable to U.S. or PCT application) was amended on \_\_\_\_\_

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with 37 C.F.R. 1.56. I hereby claim foreign priority benefits under 35 U.S.C. 119/365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed or, if no priority is claimed, before the filing date of this application:

Priority Foreign Application(s):  
Application Number Country Date/Month/Year Filed  
98 04453 France 9 April 1998

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

Application Number Date/Month/Year Filed

I hereby claim the benefit under 35 U.S.C. 120/365 of all prior United States and PCT international applications listed above or below and, insofar as the subject matter of each of the claims of this application is not disclosed in such prior applications in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose material information as defined in 37 C.F.R. 1.56 which occurred between the filing date of the prior applications and the national or PCT international filing date of this application:

Prior U.S./PCT Application(s): Status: patented  
Application Serial No. Date/Month/Year Filed pending, abandoned  
PCT/FR99/00837 9 April 1999

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon. And on behalf of the owner(s) hereof, I hereby appoint **NIXON & VANDERHYE P.C., 1100 North Glebe Rd., 6th Floor, Arlington, VA 22201-4714, telephone number (703) 816-4000 (to whom all communications are to be directed)**, and the following attorneys thereof (of the same address) individually and collectively owner's/owners' attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith and with the resulting patent: Arthur R. Crawford, 25327; Larry S. Nixon, 25640; Robert A. Vanderhye, 22076; James T. Hosmer, 30184; Robert W. Faris, 31352; Richard G. Besha, 22770; Mark E. Nusbaum, 32348; Michael J. Keenan, 32106; Bryan H. Davidson, 30251; Stanley C. Spooner, 27393; Leonard C. Mitchard, 28009; Duane M. Byers, 33363; Jeffrey H. Nelson, 30481; John R. Lastova, 33149; H. Warren Burnam, Jr. 29366; Thomas E. Byrne, 32205; Mary J. Wilson, 32955; J. Scott Davidson, 33489; Alan M. Kagen, 36178; Robert A. Molan, 29834; B. J. Sadoff, 36653; James D. Berquist, 34726; Updeep S. Gill, 37334; Michael J. Shea, 34725; Donald L. Jackson, 41090; Michelle N. Lester, 32331; Frank P. Presta, 19828; Joseph S. Presta, 35328; Joseph A. Rhoads, 37515; Raymond Y. Mah, 41428. I also authorize NIXON & Vanderhye to delete any attorney names/numbers no longer with the firm and to act and rely solely on instructions directly communicated from the person, assignee, attorney, firm, or other organization sending instructions to Nixon & Vanderhye on behalf of the owner(s).

1. Inventor's Signature: Francis R. Grieg Date: October 23rd 2000  
Inventor: Francis (first) Grieg (last) French (citizenship)  
Residence: (city) Paris (state/country) France  
Post Office Address: 8, rue de Rambouillet, Paris, France  
(Zip Code) 75012

2. Inventor's Signature: Stephane P. L. Didier Date: October 23rd 2000  
Inventor: Stephane (first) Didier (last) French (citizenship)  
Residence: (city) Paris (state/country) France  
Post Office Address: 113, rue de Meaux, Paris, France  
(Zip Code) 75019

FOR ADDITIONAL INVENTORS, check box ☐ and attach sheet with same information and signature and date for each.